PROFILE

AFV WEAPONS

44

45p
Profile

Ferrets and Fox

by R. M. Ogorkiewicz

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Edited by DUNCAN CROW

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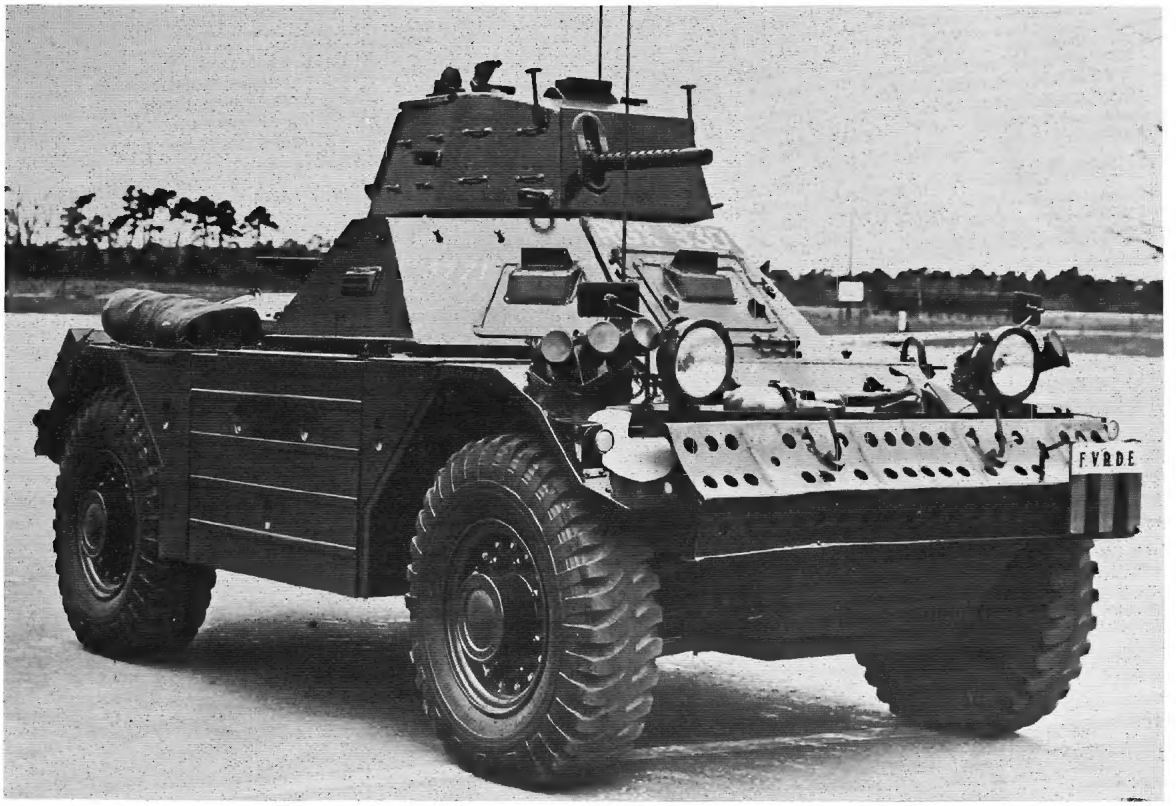


Ferret Mark 2 scout car, the most numerous member of its family. (MVEE)

Ferrets and Fox

by R. M. Ogorkiewicz

WHEELED armoured vehicles have been widely used but their effectiveness has also been frequently decried. Both phenomena are closely related to the relative ease with which wheeled armoured vehicles can be built, particularly on the chassis of other, commercial vehicles. This has made them more readily available but, on the other hand, it has also caused the great majority to be put together from components developed for other purposes instead of being properly designed to fulfill rôles compatible with their characteristics.

Thus, wheeled armoured vehicles have suffered from various shortcomings. These have not prevented their successful use under favourable conditions but have led to their condemnation under other circumstances, particularly whenever they have had to operate off the roads over muddy terrain, when they compare least favourably with tracked vehicles. However, their performance has varied considerably and at least some of the wheeled armoured vehicles designed as such have been able to compete with tracked vehicles off the road as well as enjoying their inherent superiority over them on roads.

In general, the most successful wheeled armoured vehicles have been not only the few designed as such but also the lightest. These have been at the least disadvantage in relation to tracked vehicles with regard to ground pressure, which largely governs off the road performance. In their lightest form wheeled armoured vehicles also differ most from battle tanks, which are inevitably tracked, and they are in many respects a better complement to them than corresponding light tracked vehicles.

One of the few examples of such a properly designed light wheeled armoured vehicle is provided by the Ferret scout car produced by the Daimler Company Ltd., of Coventry. This scout car was in production for twenty years and became more widely used than almost any other contemporary armoured vehicle. In several instances it also proved more useful than all other types of armoured vehicles.

DAIMLER SCOUT CAR

The design of the Ferret stems from that of an earlier Daimler scout car. This vehicle was developed to a British Army requirement in 1938 by B.S.A. Cycles Ltd., but was subsequently taken over by the Daimler Company which delivered the first production models in December 1939. By the time its production came to an end, 6,626 had been built and it became one of the only

Daimler armoured car of World War II. (Daimler)

Daimler scout car of World War II. (MVEE)

two British armoured vehicles to be produced throughout World War II, which in itself indicates how successful it was. Further evidence of the success of its design is provided by the fact that it also served as the basis of the development of the Daimler armoured car which was by far the most successful of all the various armoured cars built in Britain during World War II.

The Daimler scout car was developed to a requirement for a very light armoured vehicle for scouting and for liaison duties within armoured units. As such it was successfully used from the 1940 campaign in France through the fighting in North Africa in 1941–1943 to the final campaign in north-west Europe in 1944 and 1945. Tank regiments came to have 12, distributed between the regimental and tank squadron headquarters, while armoured car regiments, which performed reconnaissance for armoured divisions and higher formations, could have up to 61 each. In the case of armoured car regiments they were mixed with armoured cars right down to the level of the reconnaissance troop which consisted of two armoured cars and two scout cars.

FERRET MARK 1

The usefulness of the Daimler scout car led to a continued demand after World War II for this type of vehicle for liaison and scouting and also for short-range reconnaissance for which a special category of "light reconnaissance cars" existed during the war but which, in a modified form, the scout car was also deemed capable of performing. As a result, the British Army issued a requirement in 1947 for a new type of scout car. The development of this vehicle was logically entrusted to the Daimler Company which was awarded a development contract in October 1948 and in June 1950 delivered the first prototype of the new scout car.

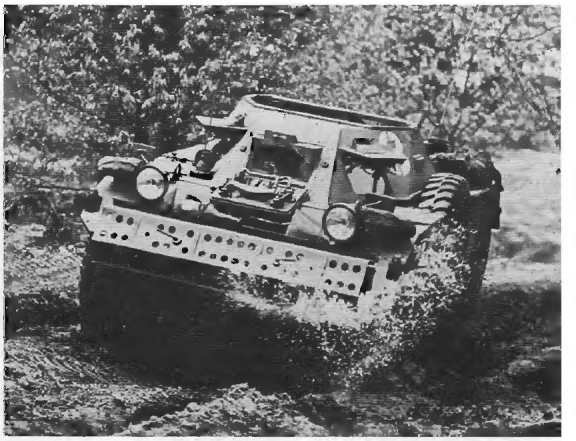
The first vehicle delivered by Daimlers was actually the prototype of what was officially called Car, Scout, 4 × 4, Liaison (Ferret) Mark 1 and was given the design serial number F.V. 701(C). This was one of several versions of the Ferret scout car to be built but it was also one which was most closely related to the original Daimler scout cars, as well as being the basic model of the Ferret series.

Like the Daimler scout car, the Mark 1 Ferret is a small

turretless vehicle and from the automotive point of view its design is essentially the same as that of its predecessor, which was well in advance of its day. In particular, it has the same H-type drive line layout. This means that the drive is taken from the engine, through the gearbox, to a differential and then shafts running fore and aft on either side of the vehicle which drive the wheels through bevel boxes at each wheel station. Such a drive line layout offers two important advantages. First, the use of a single central differential eliminates the possibility of a loss of traction due to one of the four wheels slipping. Second, the use of parallel shafts on either side of the vehicle means that the driver and the engine can be placed between them, instead of having to be above the usual drive shafts running down the centre of vehicles. As a result, the hull and the whole silhouette of a vehicle with an H-type drive line layout can be made considerably lower than those of other wheeled armoured vehicles—no higher, in fact, than that of an equivalent tracked armoured vehicle.

The suspension of the Ferret is also essentially the same as that of the Daimler scout car, its wheels being located by pairs of transverse links and sprung by single coil springs. The wheels are driven from the bevel boxes in the hull through splined shafts with a Tracta constant velocity joint at each end but, in contrast to its predecessor, the Ferret has epicyclic hub reduction gears which reduce the torques imposed on the transmission shafts.

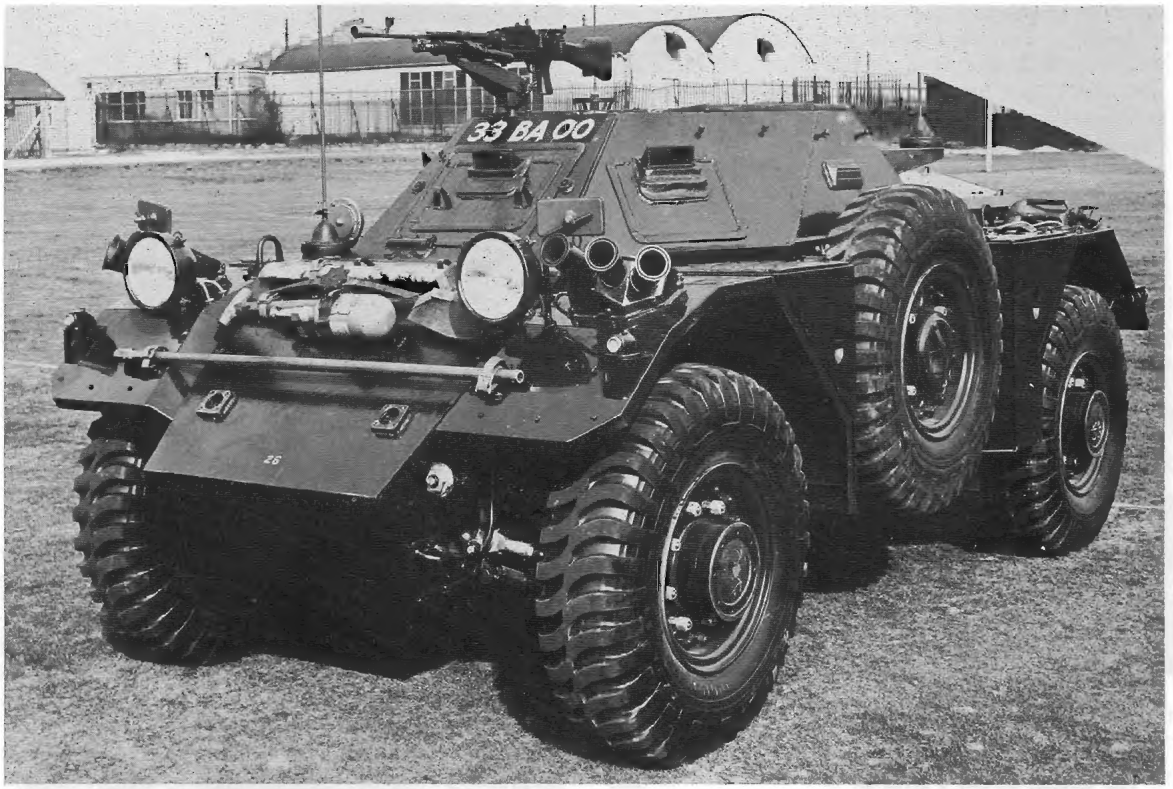
The engine of the Ferret is, however, different and more powerful than that of its predecessor. As a result, the Mark 1 has a power-to-weight ratio of 27 to 28 b.h.p. per tonne even when fully laden, compared with 17 b.h.p. per tonne of the original scout car. The engine is a Rolls-Royce B.60, a 6-cylinder water-cooled gasoline engine with a swept volume of 4·26 litres out of which it has produced 116 b.h.p. at 3,300 r.p.m. in its original version and 129 b.h.p. at 3,750 r.p.m. in its final, B.60 Mark 6A version. As before, the engine is located at the rear of the vehicle and is coupled, through a fluid coupling, to a pre-selective epicyclic gearbox with five speeds all of which can be used in reverse as well as forward.



Early version of Ferret Mark 1 demonstrating its cross-country performance. (Alvis)

Another important difference between the Ferret and its predecessor is that it has a longer wheelbase, which is 2·29 m. instead of 1·98 m. This, together with its higher power-to-weight ratio, has increased its speed over broken ground and its off-the-road performance has been improved further by the fitting of larger, 9·00 × 16

Ferret Mark 1 scout car. (MVEE)



Ferret Mark 1 scout car with Bren light machine-gun. (MVEE)

Ferret Mark 2 scout car. (MVEE)

tyres. The lengthening of the wheelbase has been accompanied by a lengthening of the hull which made it possible to sit the driver further forward, in the centre of the vehicle, instead of locating him alongside the other crew member. This, in turn, created more room in the centre of the vehicle, so that the Ferret could either carry one more man or be fitted with a turret.

The hull of the Ferret is also better shaped ballistically and is of a more efficient, integral construction, whereas the original scout car still had an armoured body mounted on a separate underbody which formed a chassis frame. The hull is welded from steel plates varying in thickness from 6 to 16 mm. which protect the crew from small arms fire and shell fragments, except from overhead as the crew compartment of the Mark 1 Ferret is open-topped.

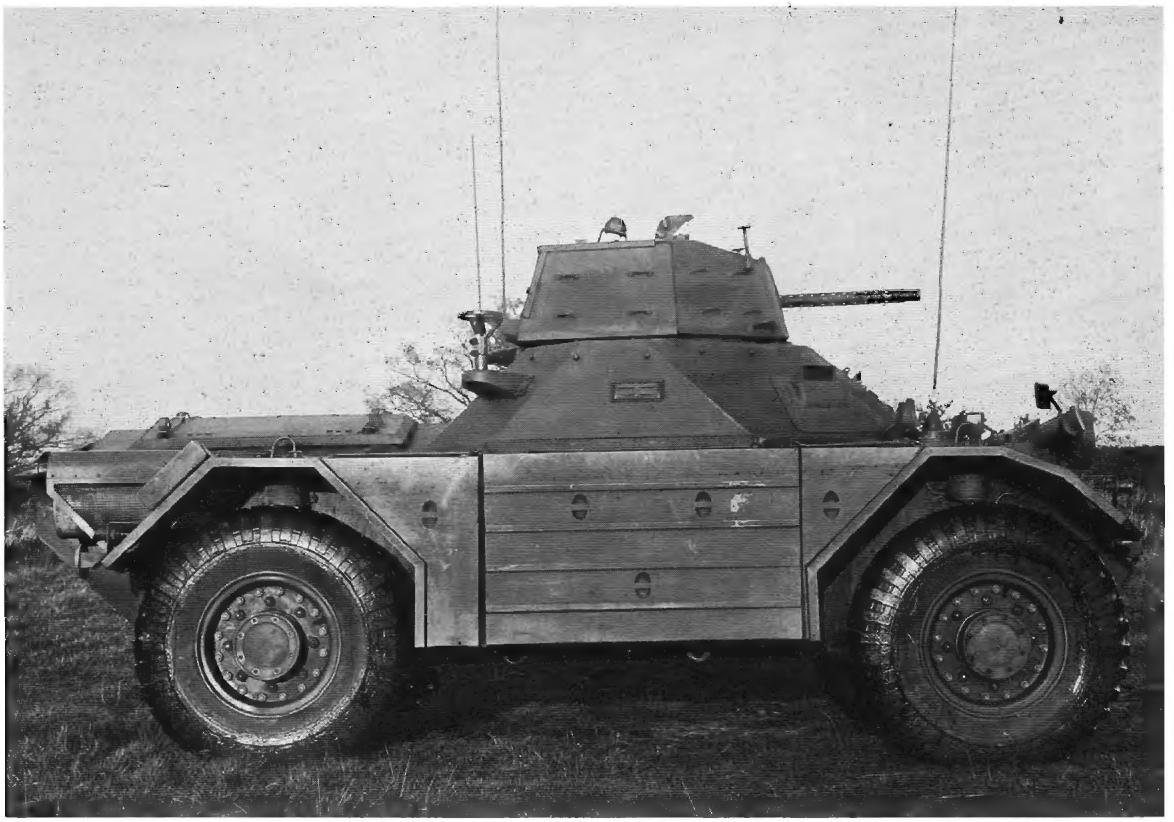
FERRET MARK 2

Although it represents a very considerable improvement on the original Daimler scout car, the effectiveness of the Mark 1 Ferret has been restricted in many circumstances by its open top and the exposed mounting of its armament, which consists only of a ·303 in. Bren or a ·30 in. Browning light machine-gun on a pintle above the hull. Its development was, therefore, followed by that of the Mark 2 which is virtually the same as the Mark 1 but is armoured all-round and has a turret. The turret is still only armed with a ·30 in. Browning machine-gun but, nevertheless, it gives the Mark 2 a far better chance of shooting its way out of trouble. This, in turn, has made the Mark 2 more suitable for reconnaissance, for while the British Army doctrine expects its reconnaissance units to obtain information by stealth rather than fighting they can not avoid having to fight their way out at times.

The reconnaissance rôle for which the Mark 2 was developed was clearly recognized by it being designated Car, Scout, 4 × 4, Reconnaissance (Ferret) Mark 2. From the automotive point of view it did not, however, differ from the Mark 1, except that its fully laden weight was 4·32 instead of 4·17 tonnes. As a result, it was put into production without any prototypes. In fact, the first production version of the Ferret was a Mark 2 which was delivered by Daimlers in October 1952, this being two months ahead of the delivery of the first production model of the Mark 1.

Originally the one-man turret mounted on the Mark 2 was the same as that of the Saracen armoured personnel carrier which was rushed into service in the early 'fifties for use against Communist terrorists in Malaya. However, its 710 mm. internal diameter was considered too small and it was replaced by a somewhat larger turret with a 760 mm. diameter ring. Otherwise only a few minor details of the Mark 2 were modified during the twenty years of its production. Thus, the final Mark 2/3, or F.V.701(H), version which was introduced in the early 'sixties differed very little from the original, F.V.701(E) model and together they became the most numerous as well as the most successful form in which the Ferrets were produced.

Side view of Ferret Mark 2 scout car. (MVEE)



Ferret Mark 1 mounted on a platform on which it was dropped by parachute. (MVEE)

Ferrets Mark 2 in service with the British Army in the Far East. (Alvis)

EMPLOYMENT

By the time the production of the Ferrets came to an end in 1971, 4,409 had been produced. Although they were developed and originally produced only for the British Army, eventually as many were made for export. Even more could have been exported but for the moralizing attitudes of British governments, which prevented the sale of Ferrets to several countries whose internal politics did not conform to the lofty notions voiced at Westminster. In spite of this, Ferrets have been used as widely as any other contemporary armoured vehicle.

The British Army used them, in the first instance, in much the same way as it used the Daimler scout cars, that is in its armoured regiments and armoured car regiments. Thus, each armoured regiment has had a reconnaissance troop of twelve Mark 2 Ferrets and two Ferrets in the headquarters of each of its three armoured squadrons, while the armoured car regiments have had two Mark 2 Ferrets, as well as two armoured cars, in each of their armoured car troops. In addition, the British Army has had an air-portable squadron equipped solely with

Ferret Mark 1/2 scout car. (Alvis)

Ferrets, and Ferrets have been used by themselves on several occasions when heavier armoured vehicles could not reach the scene of operations or were not required. Thus, a squadron of the Life Guards equipped with Ferrets was flown in July 1955 to what was then the Aden Protectorate when the need first arose to fight the insurgents there. Similarly Ferrets were the only armoured vehicles which could be delivered sufficiently quickly, this time by sea, to help British troops quell the mutiny of the Tanganyikan Army against its government in January 1964. A squadron of Ferrets also formed part of the British contribution to the United Nations police forces on Cyprus during the late 'sixties, and Ferrets have been used extensively for patrolling in many other places, including Northern Ireland. In all these security operations they have been greatly superior to tracked armoured vehicles because they are less noisy and therefore less fatiguing for their crews, and because they require less maintenance, which enables them to operate for longer periods of time.

In addition to the British Army, the Australian, Canadian and South African Armies also adopted the Ferret as their light reconnaissance vehicle, although its deliveries to South Africa were limited by a ban imposed by the British government, as were those to Rhodesia. Former British African colonies, such as Kenya, Uganda, Zambia, Nigeria, Ghana and the Sudan all acquired some Ferrets and so did Arab countries whose armed forces had been under British influence, namely Iraq, Jordan, Libya and the Persian Gulf sheikdoms.

The most significant overseas order came, however, in the mid-fifties from the French Army which was then fighting the insurgents in Algeria and urgently needed light armoured fighting vehicles. Since its withdrawal from North Africa the French Army has largely replaced the Ferrets by the similar but more heavily armed Panhard AML. However, some French units have continued to use Ferrets. For instance, a regiment of the Foreign Legion stationed in 1970 on Madagascar had attached to it a squadron of Ferrets.

Further examples of how far the use of Ferrets has spread are provided by Jamaica and by New Zealand. Other countries which have Ferrets include Indonesia, Malaysia, Brunei, Burma, Ceylon and even Somalia where there are five Ferrets among a large number of Russian-built armoured vehicles. Congo also has some, inherited from the United Nations forces which policed it between 1960 and 1964, and used in 1965 by the much publicized mercenary commandos in putting down bands of murderous rebels. Ferrets also took part in the successful action of the Nigerian Army against the Biafran separatists in 1967 and 1968.

BIG WHEELED FERRET

In the meantime various efforts were made by the Fighting Vehicles Research and Design Establishment (now the Military Vehicles and Engineering Establishment) and by Daimlers to develop the Ferrets further. One outcome of this was the development in the late 'fifties of the Mark 1/2, or F.V.704. This differed from the Mark 1, which became the Mark 1/1, in having a superstructure with an armoured roof over the opening in the centre of the hull. The superstructure increased its overall height by 0·2 m. to 1·65 m. and its weight by 150 kg., but at least it provided all-round protection and made the Mark 1/2 more suitable for use as a light reconnaissance vehicle by the infantry. In addition, the

Ferret Mark 1 with deep wading equipment.

Ferret Mark 2 with inflatable buoyancy bags.

Ferret Mark 1 in foreground and a Ferret Mark 1 with a built-out hull of reinforced plastic and polyurethane foam (Daimler)

Mark 1/2 has also been used as a commanders' vehicle in Royal Artillery troops.

Other developments included several attempts at improving Ferrets' ability to cross streams and rivers. One of these consisted of the addition of a small collapsible screen to the top of the hull of a Mark 1, whose engine compartment was also sealed but for a rubberized fabric duct. As a result the Mark 1 could wade to a depth of 1·5 m., instead of the usual 0·9 m., but the advantages of the deep wading equipment were insufficient for it to be adopted. Another attempt consisted of attaching to a Mark 2/3 a flotation kit consisting of three inflatable buoyancy bags which enabled it to float and be towed across water obstacles. However, this method was not adopted either.

A different approach was used in 1958, aimed at making the Ferret inherently amphibious. This involved building its hull out with rigid polyurethane foam covered with a glass fibre reinforced plastic skin. A Mark 1 so modified in January 1959 acquired sufficient buoyancy to float, but it only served as the basis of the next and final step which was to fit the Ferret with a collapsible flotation screen and reinforced plastics stowage boxes giving additional buoyancy. Six Mark 1 were made amphibious in this way, but the development of the flotation equipment was related more specifically to that of the Mark 4, or Big Wheeled Ferret.

The Mark 4 arose out of the experience with the Mark 1 and 2 and the requirement that the Ferret should be amphibious. The former showed the need for larger brakes and bigger tyres which, together with the need for greater buoyancy, led to the adoption of a wider track suspension with larger 11·00 × 20 tyres and disc instead of drum brakes. At the same time the collapsible flotation screen was adopted to meet the requirement for swimming across inland water obstacles.

The new components could have been fitted either to the Mark 1 or the Mark 2. However, no Big Wheeled version of the Mark 1, which would have been the Mark 3, was built. Instead, further development of the Ferrets was concentrated on the Mark 2, which was developed into the Big Wheeled Mark 4, or F.V.711. The Mark 4 came into service with the British Army in 1970 and due

Ferret Mark 1/3 with flotation screen (MVEE)

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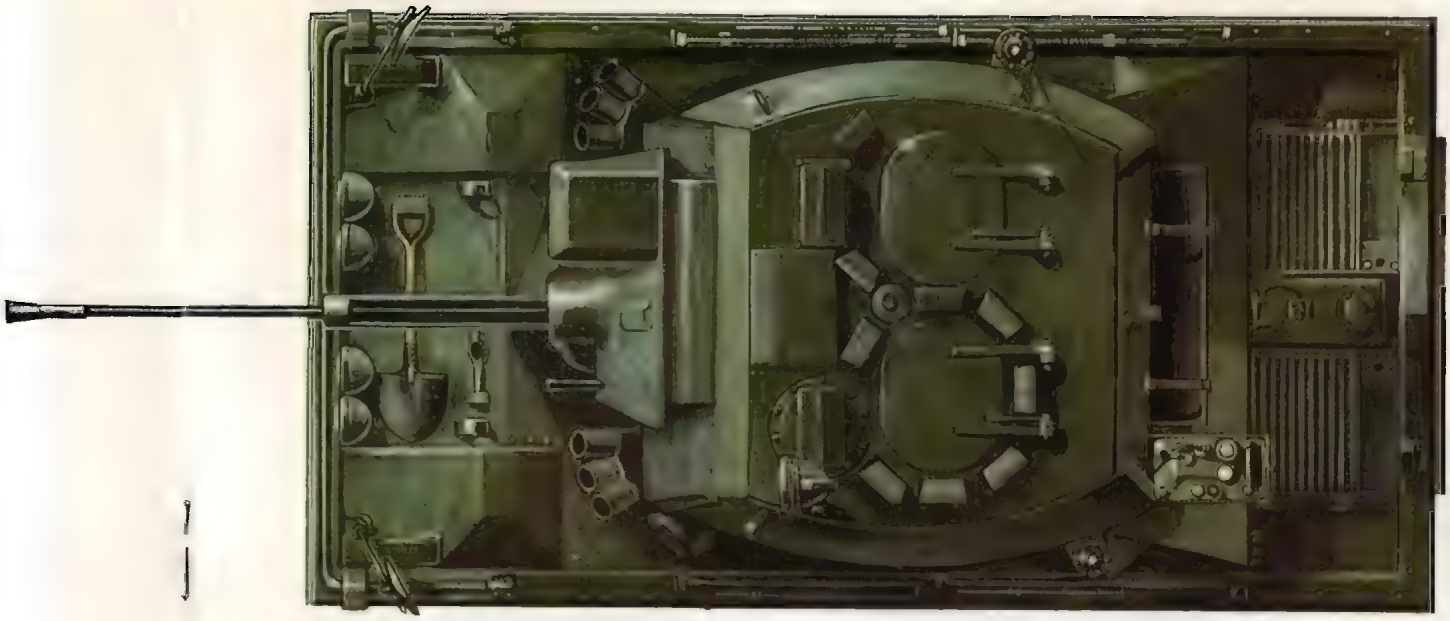
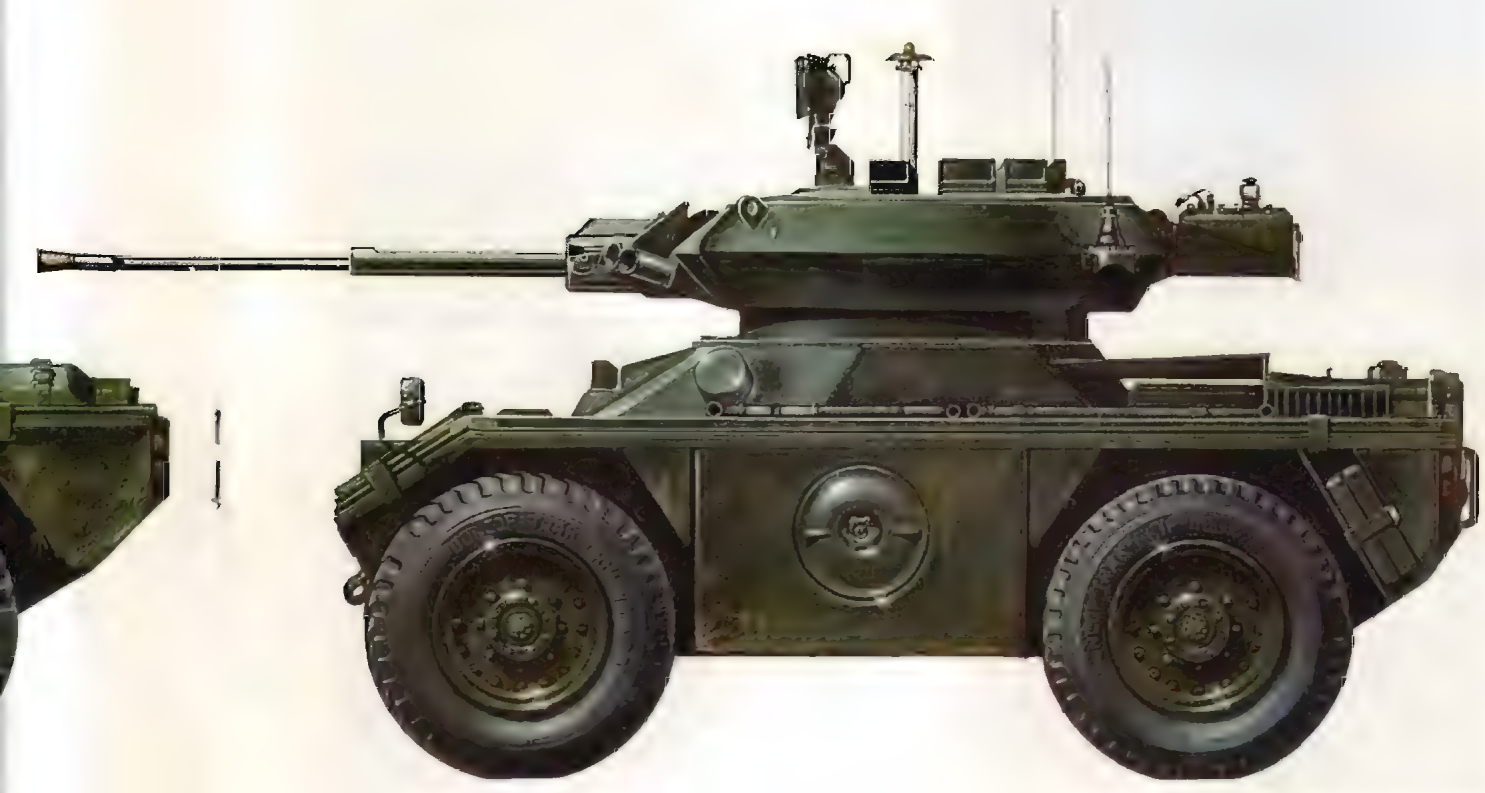


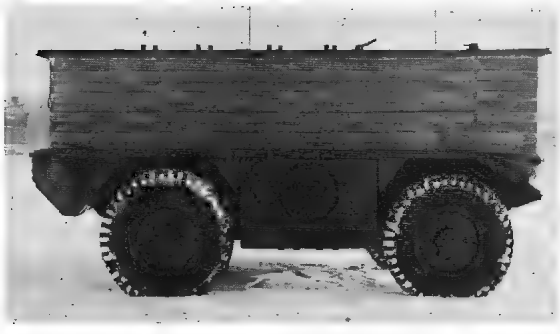
Top left/right and bottom right: 3 views of the Fox.

Bottom left: side view of Ferret Mk. 4.

T. Hadler © Profile Publications Ltd.



Ferret Mark 4. (Alvis)



Ferret Mark 4 with flotation screen erected. (Alvis)

to its larger diameter tyres and flotation equipment constituted a significant advance in cross-country mobility on the earlier Ferrets.

MISSILE-ARMED FERRETS

Work on improving the automotive performance and tactical mobility of the Ferrets was accompanied by the mounting in them of more powerful armament. This led, in the first instance, to the Mark 2/6, which is a Mark 2 fitted with Vigilant anti-tank guided missiles.

Development of the Mark 2/6, or F.V.703, began in 1960 and resulted in the mounting of a Vigilant missile container-cum-launcher on each side of the turret and of two additional missile containers on the left of the hull, in place of the spare wheel. The Vigilant was originally developed by Vickers-Armstrong Ltd. as a man-portable infantry anti-tank weapon and like other first-generation missiles it relies on manual command guidance and a trailing wire link. As a result it can be controlled either from the vehicle turret or away from it, using the original, infantry-type sight/controller and a separation cable, which means that the missile launching vehicle can be kept under cover in some favourable circumstances. Its original purpose also made the Vigilant relatively light, which made it easier to install, but in spite of its light weight it has a shaped charge warhead capable of penetrating the armour of battle tanks. In consequence, the mounting of Vigilants on Ferrets has greatly increased the anti-tank capabilities of armoured car regiments in which one of the two Mark 2 Ferrets in each troop was replaced in the mid-sixties by a Mark 2/6. The air portable squadron also benefited from the development of the Mark 2/6, which forms one half of its strength and enables it to engage battle tanks while equipped with Ferrets instead of the earlier air-portable Hornet wheeled launcher with its clumsy, Australian-developed Malkara missiles.

Although it is effective, the Mark 2/6 has been only a makeshift for a properly designed missile version of the Ferret whose development did, in fact, start in 1962. The new model was essentially a Mark 4 but with a larger, 810 mm. diameter ring turret, the design of which started in January 1963. Instead of steel the new turret was welded from aluminium alloy extrusions and plates, and the version of the Ferret fitted with it, which was designated the Mark 5, became the first British fighting vehicle with aluminium armour.

The turret of the Mark 5, or F.V.712, was designed to

Ferret Mark 2/6 with Vigilant anti-tank guided missiles. (MVEE)

Vigilant anti-tank guided missile fired from a Ferret Mark 2/6. (Alvis)

hold four ready-to-fire guided missiles mounted in pairs on either side. The missile launching boxes are elevated for firing but otherwise the missiles are fully protected by armour, which represents a considerable advance on the Mark 2/6 and on earlier missile installations. In addition to the turret-mounted missiles two more can be stowed on the hull and the turret is also fitted with a 7·62 mm. machine-gun.

The missiles mounted in the Mark 5 are the Swingfire second-generation missiles which were developed specifically for the Royal Armoured Corps by the British Aircraft Corporation but which are, neverthless, similar in principle to the Vigilant. Thus, they rely on manual command guidance and a trailing wire link and can be controlled either from the turret or from a position remote from the vehicle. However, the Swingfire is much more lethal than the Vigilant, having a larger diameter shaped-charge warhead, and has a longer, 4,000 metre range. As a result, the Mark 5 forms a highly effective long-range tank destroyer and at one time the production of several hundred was contemplated. However, only a small number of the Mark 5 was actually built, the first coming into service with the British Army in 1968.

The reason why the Mark 5 was not produced in quantity was a switch by the British Army in the mid-sixties from its well-founded practice of using wheeled reconnaissance vehicles to the development of tracked reconnaissance vehicles. The latter have taken the form of the CVR(T), or Combat Vehicle, Reconnaissance, Tracked, and include the Striker anti-tank guided weapon vehicle with Swingfire missiles. Originally it was thought that this vehicle would have the same turret as the Mark 5 but the Striker was eventually developed into a turretless vehicle with five ready-to-fire missiles in

Ferret Mark 5 with mock-up turret for Swingfire missiles
(British Aircraft Corp.)

Ferret Mark 5 with a Swingfire missile emerging out of its container/launcher
(British Aircraft Corp.)

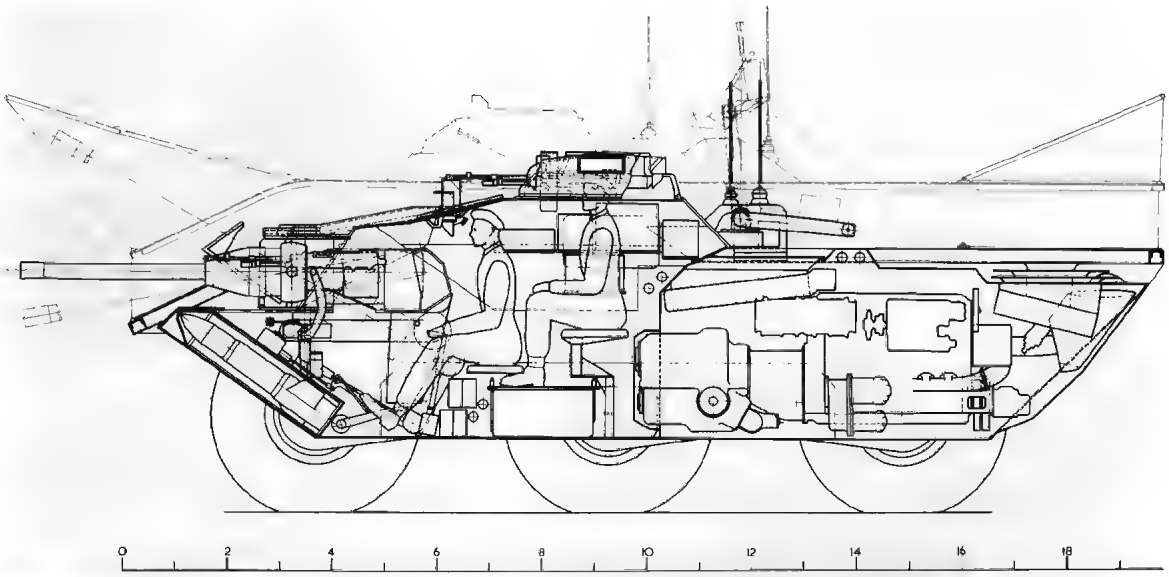
an armoured container which can be elevated but not traversed. Apart from having one more ready-to-fire missile, the Striker also carries five, instead of two, additional missiles but it is more than 2 tonnes heavier than the Mark 5.

AVR AND TV 1000

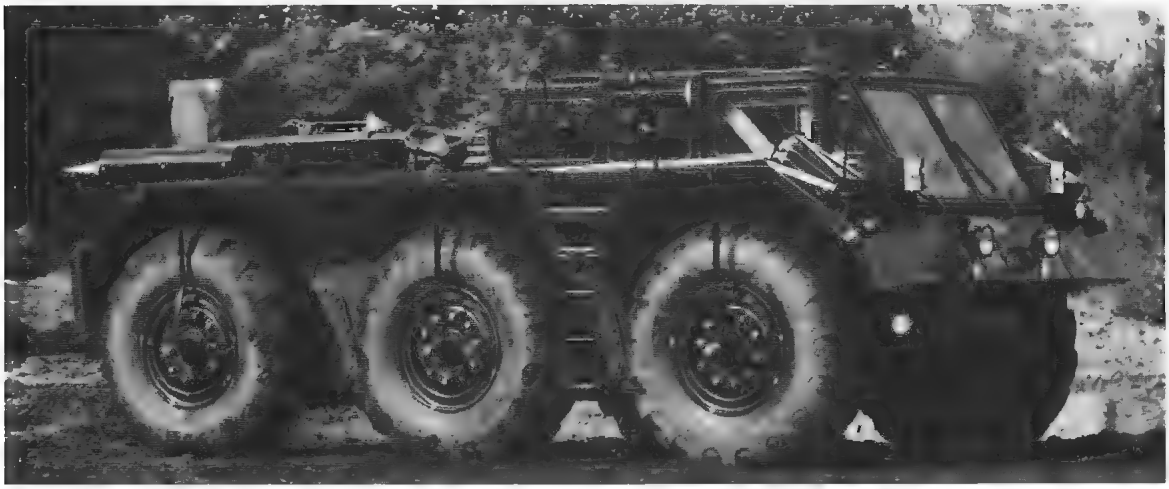
The development of the CVR(T) also led to a successor to the Ferrets, namely the Combat Vehicle, Reconnaissance, Wheeled, or CVR(W). The origins of both the CVR(T) and CVR(W) go back to 1960 when the British Army began to consider a successor to the Saladin armoured car which had become its principal armoured reconnaissance vehicle. This was conceived as a highly sophisticated vehicle, called the AVR or Armoured Vehicle, Reconnaissance, which would be capable of performing several rôles. In consequence it was to be armed with guided missiles as well as a medium velocity 76 or 105 mm. gun and weigh around 13 tonnes.

The original AVR design put forward in 1960 by the Fighting Vehicles Research and Development Establishment envisaged a tracked vehicle. However, an alternative, 1963 FVRDE design proposed a six-wheeled AVR which was to weigh 13·6 tonnes and be armed with Swingfire missiles as well as a 76 mm. gun. The design took two different forms, one being turreted and the other turretless, which was particularly attractive for a reconnaissance vehicle as it reduced its silhouette and thus made it far less conspicuous. In either case, however, the wheeled AVR was to be skid-steered, like a tracked vehicle, instead of being steered like other wheeled vehicles by turning its wheels.

Prototype of Ferret Mark 5 with missile containers raised into their firing position.
(Alvis)

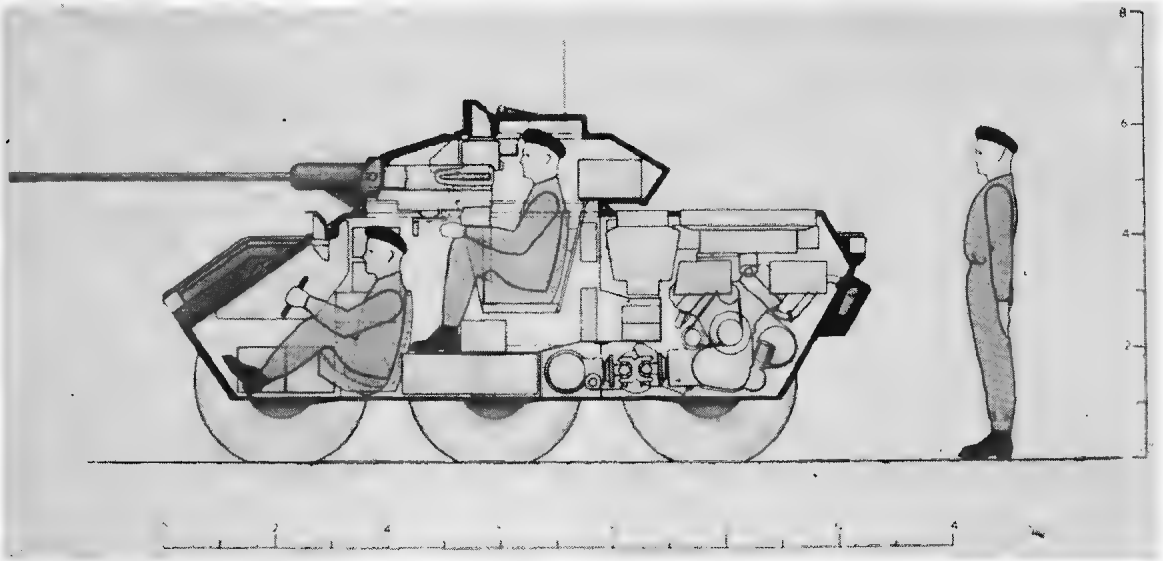


Turretless version of a six-wheeled AVR with skid-steering designed in 1963. (MVEE)



TV 1000 test vehicle with skid-steering.

Light AVR with skid-steering designed in 1964. (MVEE)



The use of skid steering in the AVR followed the construction of a larger test vehicle with skid steering, the TV 1000. This was a 20-tonnes vehicle with six wheels, with large 18·00 × 24 tyres, which could not be turned in relation to the hull but which were driven through a Centurion tank transmission with its triple differential steering system and a system of chains on either side of the hull. The TV 1000 was designed in 1956–1957 as a possible basis for the development of a wheeled tank, its advantage over more conventional wheeled vehicles being that its hull could be wider in relation to its overall width because no space had to be provided for the turning of its wheels. In fact, its hull was as wide as that of an equivalent tracked vehicle. However, it suffered from the same fundamental disadvantage as tracked vehicles, namely that it could only be steered by creating a difference between the thrusts generated by the wheels on each side. On soft ground, when the soil under the wheels is stressed to its limit, the slewing moment necessary for steering can only be obtained by reducing the thrust on one side of the vehicle, since it is not possible to increase that on the other. Thus, skid-steering is accompanied by a reduction in the total forward thrust and in soft ground leads to a complete immobilisation of the vehicle. Moreover, the TV 1000 wore its tyres rapidly and, like other skid-steered vehicles, was inherently less stable when running fast on roads.

The proposal for the skid-steered AVR did not get very far as it was rejected together with that for the tracked AVR in 1963, when both were adjudged too heavy, particularly from the point of view of air-portability which was considered important because the strategic planners still imagined that British troops would be required to fly to defend or police different parts of the Commonwealth, in spite of its gradual and inevitable dissolution. In consequence, two new proposals were put forward by FVRDE in 1964. One was for a family of light tracked vehicles, which was accepted and led to the Scorpion and other CVR(T)s. The other was for a series of light, 6 to 8 tonnes, six-wheeled vehicles with skid steering, which was rejected. The decision to reject the second alternative was strongly influenced by trials conducted in 1964 by the Royal Armoured Corps School of Tank Technology over muddy ground at Tyneham in Dorset which demonstrated the fundamental weakness of the skid-steering of TV 1000.

FOX CVR(W)

The decisions in favour of tracked reconnaissance vehicles and against skid-steered wheeled vehicles did not, fortunately, put an end to further development of other wheeled vehicles. However, in view of the commitment to the CVR(T) family, the development of wheeled armoured vehicles could only continue on a modest scale. Thus, in 1965, FVRDE proposed that the Ferret be developed further. This involved welding its hull out of aluminium armour instead of steel, replacing its Rolls-Royce engine by the more powerful Jaguar XK which was adopted at about the same time for the CVR(T), and mounting on it a two-man turret, with a 30 mm. gun, which was originally designed for the lightest of the six-wheeled skid-steered AVR designs of 1964. The redesigned vehicle was accepted in 1966 as the Fox CVR(W) and Daimlers proceeded to develop it. As a result its first prototype was built in November 1967,

Prototype of the Fox with a dummy turret. (MVEE)

which was more than a year earlier than the first CVR(T).

Fourteen more prototypes were built by Daimlers by April 1969 but in the meantime, in August 1968, the user trials of the Fox had started and in July 1970 it was accepted for production for the British Army. Unfortunately the production order for the Fox did not go to Daimlers but to the Royal Ordnance Factory in Leeds. The latter had established a high reputation for the production of battle tanks but by taking the Fox order from Daimlers it deprived British armoured vehicle development of a valuable link with the automotive industry, as Daimlers ceased to build armoured vehicles when they completed their last order for Ferrets. The diversion of the Fox order from Daimlers also broke a unique connection between them and armoured vehicles which went as far back as the "war car" built by F.R. Simms in 1902 and the very first British tank of 1915, both of which were powered by Daimler engines.

ALUMINIUM ARMOUR

One of the most interesting features of the Fox is its armour, which makes it the world's first all-aluminium armoured car. The armour is of a heat treated, 7039 type aluminium-zinc-magnesium alloy similar to that used in the CVR(T) and second-generation American aluminium armoured vehicles. The alloy is used mainly in the form of rolled plate but extrusions are also used in the construction of the turret and some particularly important parts are produced by forging. Because aluminium armour has to be thicker, though not heavier, than steel armour to provide the same degree of protection the hull of the Fox is sufficiently rigid to dispense with a number of stiffeners required in similar steel-armoured vehicles, which saves weight and cost and has also improved access to the engine.

In addition to being used for the armour of the hull and turret, aluminium alloys are also used for several other components of the Fox, including the forged suspension wishbones and the cylinder head of the XK engine. The engine is a militarised version of the 4·2 litre 6-cylinder water-cooled Jaguar car engine with a lower, 7·75:1 compression ratio to enable it to operate on low octane number gasoline. However, even in its derated form the XK engine develops 195 b.h.p. at 4,750 rev/min and gives the Fox a higher power-to-weight ratio than that of any of the Ferrets.

Other automotive characteristics of the Fox are much the same as those of the Ferret Mark 4, except that it has power steering. In particular, it has the same type of

Prototype of the Fox with turret mounting a 30 mm. Rarden gun. (Alvis)

Rear view of a Fox prototype with Radiac mast on the turret. (MVEE)

Late development version of the Fox with surveillance radar. (MVEE)

Daimler fluid coupling and 5-speed preselective epicyclic gearbox; spiral bevel directional control gears make all five speeds available in reverse as well as forward.

One of the developments carried over from the Mark 4 Ferret is the permanent installation on the Fox of a collapsible flotation screen which can be erected by the crew in little more than one minute. When afloat the Fox can propel itself at up to 5·2 km./hr. by means of its wheels.

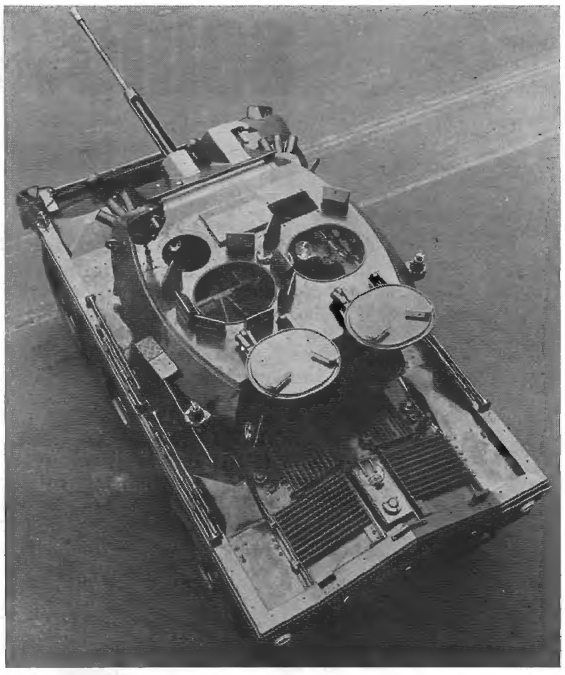
The most important difference between the Fox and its predecessors is its larger turret with a 30 mm. Rarden gun and a coaxial 7·62 mm. machine-gun. The turret has a ring diameter of 1·27 m. which makes it large enough to accommodate not only a gunner but also a commander, who also acts as a loader. To enable him to observe effectively from within the vehicle, the commander is provided with a ring of seven unity magnification periscopes around his hatch and a periscopic binocular surveillance instrument, with a magnification of ten or unity, in a rotating mount. The gunner has two additional periscopes as well as a periscopic binocular sight linked to the armament and a separate passive night sight. The driver, who completes the crew of three, has a single wide-angle periscope.

The 30 mm. Rarden gun of the Fox was developed specially for light armoured vehicles by the Royal Armament Research and Development Establishment and the Royal Small Arms Factory Enfield whose combined initials have given it its name. It was designed to fire the well-proved 30 mm. ammunition originally developed in Switzerland by the Hispano Suiza Company for automatic anti-aircraft guns but, in addition, it has been provided with APDS ammunition developed in Britain. The APDS projectiles of the Rarden have a muzzle velocity of more than 1,200 m/s which enables it to defeat the armour of all fighting vehicles, except for the frontal armour of battle tanks. As it also fires high explosive shells and can be elevated to 40 degrees for firing against low flying attack aircraft or helicopters the 30 mm. Rarden makes the Fox a most effective light wheeled armoured vehicle.

VIXEN LIAISON VEHICLE

The development of the Ferrets into the Fox produced what was in many ways a modern equivalent of the Daimler armoured car. By the same token it left room for the development of a successor to the original Daimler scout car and Ferret Mark 1. In consequence a liaison vehicle based on the Fox began to be studied in 1968. At first it was intended to have not only the same automotive components as the Fox but also the same hull, with a superstructure instead of the 30 mm. gun turret. However, the resulting "Tall Fox" would have had an undesirably high silhouette. As a result, another design was produced for a "Fat Fox" which had a special, lower and wider hull. This was accepted in 1970 as the Vixen CVR(W) Liaison. Thus, when the Royal Ordnance Factory in Leeds received an order in 1971 for producing the Fox

A Fox prototype demonstrating its ability to climb a steep slope. (Alvis)



Overhead view of a Fox prototype. (Alvis)

it also received an order to build prototypes of the Vixen.

Because it does not have a gun turret like the Fox, the Vixen can accommodate four, instead of three, men and its hull also provides ample room for different types of radio equipment. It is also simpler and cheaper than the Fox. However, its armament is confined to a single 7·62 mm. machine-gun, mounted in a small one-man turret originally developed for the F.V.432 tracked armoured personnel carrier, which makes it no better in this respect than the Ferret Mark 2. At the same time it is more than a ton heavier than the Ferret Mark 1 and 0·56 m. higher. In fact, its overall height of 2 m. makes it as high as the tallest of the Ferrets, namely the Mark 4 and 5, and not much lower than the Fox.

Fox coming ashore with its flotation screen erected. (MVEE)

Fox moving at high speed. (Alvis)

SUMMARY OF VEHICLE CHARACTERISTICS

Vehicle	Daimler Scout Car Mark II	Daimler Armoured Car Mark I	Ferret Scout Car Mark I	Ferret Scout Car Mark 4	Fox Armoured Car
Weight, unladen, tonnes	2·64	6·25	3·51	4·73	5·20
laden,	3·30	7·1	4·22	5·40	6·12
Tyre size	7·00 × 18	10·5 × 20	9·00 × 16	11·00 × 20	11·00 × 20
Wheelbase, m.	1·98	2·59	2·29	2·29	2·29
Wheel track, m.	1·47	1·98	1·55	1·75	1·75
Overall length, m.	3·16	3·96	3·84	3·96	4·17*
width, m.	1·71	2·44	1·91	2·13	2·13
height, m.	1·50	2·24	1·45	2·03	2·25
Ground clearance, m.	0·25	0·41	0·33	0·41	0·41
Engine, make	Daimler	Daimler	Rolls-Royce	Rolls-Royce	Jaguar
model	—	—	B.60	B.60	XK
capacity, litres.	2·5	4·09	4·26	4·26	4·26
gross b.h.p.	55	95	116	129	195
B.h.p. per tonne	17	13	27	24	32
Max road speed, km./h.	88	80	93	80	100
Range on roads, km.	300	300	300	300	330
Armament, gun,	none	40 mm.	none	none	30 mm.
machine-gun	·303 in.	7·92 mm.	·303 in.	7·62 mm.	7·62 mm.
Crew	2	3	2-3	2	3

*vehicle only

Overhead view of the Vixen mock-up. (MVEE)

Acknowledgements

The author wishes to thank the Military Vehicles and Engineering Establishment and the Daimler Company Limited for information about the history and characteristics of the Ferret and Fox family of wheeled armoured vehicles. The author also wishes to thank the Military Vehicles and Engineering Establishment, the Daimler Company Limited, Alvis Limited and the British Aircraft Corporation Guided Weapons Division for their generous help with photographs.

AFV/Weapons Series Editor:
DUNCAN CROW

Wooden mock-up of the Vixen liaison vehicle. (MVEE)

AFV/Weapons Profiles

Edited by DUNCAN CROW

FORTHCOMING TITLES:

45 Vickers 37-ton Main Battle Tank

Called by the Indian Army "Vijayanta" (Freedom) this Main Battle Tank (the latest in half a century of tank design and tank production) was built by Vickers to meet an Indian request for a tank to replace the Centurion as India's standard battle tank. It incorporates the Chieftain power pack, gearbox, steering unit and brakes, and is now also being built in India: BY R. M. OGORKIEWICZ.

46 Light Tanks M22 (Locust) and M24 (Chaffee)

In appearance rather like a miniature Sherman, the M22, called by the British the Locust, was designed as an airborne tank for the U.S. Army in World War II. But none were used in action by the Americans. The British, however, included some in the Rhine crossing operations of 6th Airborne Division in XVIII U.S. Airborne Corps. The M24 (Chaffee) though classified as a light tank was equivalent to the early British cruisers in weight and superior to them in armament. Though the Chaffee came in at the tail end of WWII, its days of glory were in Korea where it had to withstand the onslaught of North Korea's Russian T34/85s at the beginning of that war. It was still on active service in the Indo-Pakistan war in December 1971: BY COLONEL ROBERT J. ICKS. (M22 is new, M24 is a revised Armour in Profile.)

47 T-34

The development of the Russian T–34 tank and the discomfiture and surprise of the German Army in finding its panzers outclassed by the T-34/76 ("the best tank in any army up to 1943" in Guderian's judgment) are described BY J. M. BRERETON. In the second half of this *Profile* a description of the even more powerful T–34/85 with its increased firepower, and a critique of the T–34 in service, are given BY MAJOR MICHAEL NORMAN, Royal Tank Regiment. (T34/76 is a revised Armour in Profile, T–34/85 is new).

48 PanzerKampfwagen VI - Tiger I and II

"Slow and heavy, large and cumbersome" the Tiger may have been, but it was a formidable tank to encounter and could stand tremendous punishment on its thick frontal armour. This Profile tells the story of the legendary Tiger – both the Tiger I (SdKfz 181) and the Tiger II or King Tiger (SdKfz 182). They had their drawbacks from the logistic and tactical points of view – faults that were rarely apparent to those who had to face them. Also included is the "tank hunter" version of the King Tiger – the Jagdtiger – and an account of the super-heavy tank projects, the Maus and the E100. (Tiger I is a revised Armour in Profile, the rest is new).

49 Japanese Medium Tanks

Japanese tank development started from 1925. One of the officers of the Imperial Japanese Army concerned with this development from the very outset was Captain (now LIEUTENANT-GENERAL) TOMIO HARA. From his own unrivalled personal experience General Hara in this Profile describes the designing, building, and performance of Japanese medium tanks from Prototype No. 1 (1925-27) through Type 89 (1929), Type 97 (CHIHA) (1937), Type 1 (CHIHE) (1940), Type 3 (CHINU) (1943), Type 4 (CHITO) (1943), to Type 5 (CHIRI) (1944). Also included is a detailed explanation of the year/model designation given to Japanese tanks and the abbreviations used in nomenclatures: BY LIEUT.-GENERAL TOMIO HARA, *Imperial Japanese Army, Retd.*

FUTURE TITLES WILL INCLUDE

Swiss Pz 61 and 68 Medium Tanks

Prototypes of the Pz 61, the Swiss Army's Main Battle Tank, were built in 1958 and 1959 and pre-production vehicles with a 90mm gun appeared in 1961: they were designated Pz 58. The Pz 58 was then equipped with a 105mm gun and went into production as the Pz 61. The Pz 68 is a further development. By R. M. OGORKIEWICZ.

The Abbot

The Abbot (FV 433 105mm Field Artillery Self-Propelled) is the first British gun designed specifically for the self-propelled role. It was produced to replace the 25pdr field gun and went into troop service in 1965 when the first regiment to be equipped with it was the 3rd Royal Horse Artillery. This Profile by CHRISTOPHER F. FOSS also includes the Value Engineered Abbot and the Falcon Anti-Aircraft System.

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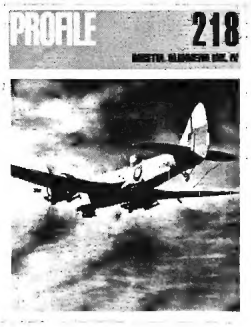

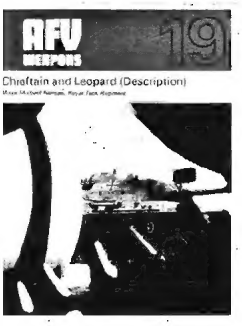

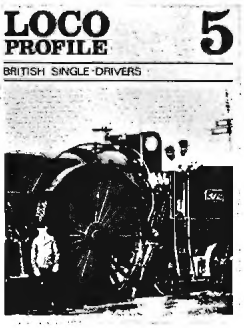

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